(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 November 2000 (30.11.2000)

PCT

(10) International Publication Number
WO 00/71453 A1

(51) International Patent Classification[7]: B65H 19/22

(21) International Application Number: PCT/FI00/00442

(22) International Filing Date: 17 May 2000 (17.05.2000)

(25) Filing Language: Finnish

(26) Publication Language: English

(30) Priority Data:
991169 24 May 1999 (24.05.1999) FI

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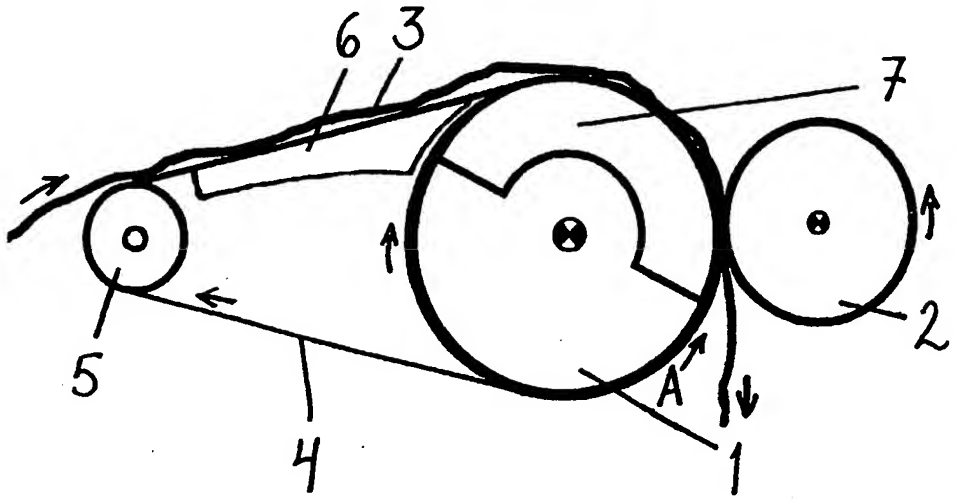
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR THREADING THE TAIL OF A WEB IN A REEL-UP OF PAPER WEB



(57) Abstract: In a method for threading a tail of a web in a reel-up of paper web, in which a paper web (W) is passed over the shell of a reeling cylinder (1) on top of an air permeable supporting belt (4) to contact with a reel spool (2) while the web is kept against the belt by means of a suction effective through the shell of the reeling cylinder. The supporting belt (4) is passed in a loop around the reeling cylinder (1), which forms a reversing cylinder for the loop of the supporting belt (4).

WO 00/71453 A1

Method and apparatus for threading the tail of a web in a reel-up of paper web

The invention relates to a method for threading the tail of a web in a reel-up of paper web, the method being of the type presented in the preamble of the appended claim 1. The invention also relates to an apparatus for threading the tail of a web, which is of the type presented in the preamble of the appended claim 7.

After a web break or a stoppage, the paper web has to be passed through the machine again. In the process of threading the paper web, a narrower leader strip separated from the full-width web is guided to a reeling cylinder and passed down to a pulper, whereafter the leader strip is spread to form a full-width web and transferred by means of a suitable method around an empty reel spool brought to the reel-up. Thereafter it is possible to start a continuous reeling up to form machine reels, wherein in connection with the reel changes the full-width web passed to the full reel is changed around the new reel spool by means of a suitable change method.

As is well known, for guiding the leader strip there are different auxiliary means, such as threading ropes and air blowings guiding the leader strip. The aim is to attain a tail threading without ropes, wherein threading ropes and rope pulleys guiding the same would not be necessary, and the leader strip could be guided in other ways. A typical problem in the guidance of the leader strip is that at high speed the strip tends to hit various obstacles, or to deviate from the intended direction. Such problems occur in all those sections in which the web is not e.g. supported on both sides, for example between the shell of a cylinder or a roll and a supporting fabric. Because of this, the act of passing the leader strip to the reel-up and over the reeling cylinder is also demanding.

The European patent 658504 and the related US patent 5531396 disclose a reel-up which is provided with an air permeable supporting belt which in the form of a loop is passed over the reeling cylinder and guided by means of a movable auxiliary roll positioned in the machine

direction diagonally downwards from the reeling cylinder so that it also travels against the perimeter of the machine reel being reeled from the web. The loop of the supporting web travels over the reeling cylinder in a small sector, and thereafter diagonally downwards to the auxiliary roll and further to the guiding rolls below the auxiliary roll, which turn the belt so that it returns to its initial point which is a roll located before the frame of the reel-up. The air permeable belt covers the entire width of the web. The reeling cylinder is equipped with a suction sector to keep the web against the supporting belt, and underneath the supporting belt before the reeling cylinder there may also be a suction box, which ensures that the web is retained on the belt before the reeling cylinder.

By means of said arrangement, it is possible to pass the web by means of the supporting belt in a supported manner all the way from the calender to the reel-up, and this support can also be utilized in the act of passing the leader strip to the reel-up. By means of the belt it is also possible to pass the web in a supported manner via the auxiliary roll from the reeling cylinder to the reel, which has been transferred away from the reeling cylinder, and the auxiliary roll then presses the belt and the web against the reel to prevent the slackening of the reel. The aforementioned purposes result in a long belt loop, which requires several guiding rolls and thus increases the number of parts in the reel-up.

It is an aim of the present invention to introduce a new method, by means of which the critical points of the threading can be implemented in a less complicated manner. To implement this purpose, the method according to the invention is primarily characterized in what will be presented in the characterizing part of the appended claim 1. The air permeable supporting belt is passed in a loop around the reeling cylinder, which forms a reversing cylinder, i.e. it turns the loop of the supporting belt so that it starts to travel in the opposite direction to the return section towards the initial point of the web conveying section. In its simplest form the loop is formed by means of a reeling cylinder and a reversing roll located before the reeling cylinder. The amount of supporting belt and the number of the rolls guiding the same is smaller, and the leader strip and the full-width web are allowed to fall into the

pulper or to a corresponding broke processing system from the top of the belt travelling on the perimeter of the reeling cylinder. During the normal reeling process, the supporting belt travels through the reeling nip on the surface of the reeling cylinder, and continues thereafter on the surface of the reeling cylinder towards the return section of the supporting belt loop. It is also possible that the supporting belt loop is located outside the edge of the actual web in the edge of the reeling cylinder, wherein its width is suitable for the leader strip.

Suction is effected via the shell of the reeling cylinder, which, by virtue of the air permeability of the supporting belt, keeps the tail or the web against the surface of the supporting belt. The suction is arranged effective in that section within which the supporting belt travels over the reeling cylinder, and preferably the suction area begins in the direction of rotation of the reeling cylinder before the point where the supporting belt enters the reeling cylinder.

By means of the aforementioned solution it is possible to pass the web either as a narrower leader strip or as a full-width web down to the reel-up, and to run it in a conventional manner down to the pulper or to the corresponding broke processing system after the reeling cylinder.

As for the other preferred embodiments of the invention, reference is made to the appended dependent claims 2 to 6 and to the description hereinbelow. For example before the reeling cylinder, a second suction can be arranged below the supporting belt by means of a suction box or the like.

The apparatus according to the invention, in turn, is characterized in what will be presented in the characterizing part of the appended claim 7. A supported transport of the web to the reel-up and after the reel-up to the broke processing system by means of a simple structure is attained by means of a short, air permeable supporting belt loop provided with a reeling cylinder in one end and with a reversing roll in the other end.

As for the other preferred embodiments of the apparatus, reference is made to the appended depended claims 8 to 12 and to the description hereinbelow.

In the following, the invention will be described in more detail with reference to the appended drawings, in which

Fig. 1 shows a side view of the apparatus according to the invention,

Fig. 2 shows the principle of a suction device used inside the reeling cylinder or underneath the supporting belt,

Fig. 3 shows an embodiment of the apparatus in a more detailed sectional view,

Fig. 4 shows a detail of Fig. 3,

Fig. 5 shows the threading of the tail in a perspective view of the apparatus, and

Fig. 6 shows a perspective view of a threading apparatus for a full-width web.

Fig. 1 shows a side-view of the apparatus. The reel-up in the terminal end of a paper machine or a finishing machine for paper includes a rotating reeling cylinder 1, which is equipped with a drive and journalled rotatable to a stationary bearing pedestal in the reel-up. As is well known, the reeling cylinder guides the web passed to the reel-up on the reel spool 2 in such a way that it is in contact with the reel spool 2 to form a reeling nip. Machine reels are reeled around the reel spool 2 in a manner known as such from a full-width web passed from the preceding machine sections at high speed (in paper machines typically over 1000 m/min). The web travels to the reel through the nip formed by the reeling cylinder 1 and the reel spool 2. The drawing illustrates a situation where a leader strip 3 travels through the reeling nip between the reeling cylinder 1 and the empty reel spool 2, and down to broke

processing system, such as a pulper, before the continuous reeling begins. The reel spool 2 can also be rotated by means of a centre-drive, and in the initial position of Fig. 1 as well as during the actual reeling process, it can be loaded against the reeling cylinder 1 by means of loading devices, which, not being part of the invention, are not shown. The reel spool 2 is also supported by its ends on a suitable supporting structure, for example on top of rails extending in the machine direction, or it is positioned on the support of a carriage movable in the machine direction.

A supporting belt 4, which is at least as wide as the full-width web, is passed around the reeling cylinder 1 to form an endless belt loop. The supporting belt can be a suitable, air-permeable, relatively thin and flexible supporting structure, such as a supporting wire. In the supporting wire, openings which make the permeation of air possible, are produced between thread-like elements, as in a woven structure. The supporting belt 4 is passed as a loop around the reeling cylinder 1 in such a manner that the reeling cylinder provides the turning point of the loop, i.e. a reversing cylinder. In the travel direction of the web before the reeling cylinder 1 there is the second reversing roll 5 of the loop, which guides the return section coming as a straight run from the reeling cylinder 1 to a conveying section directed back to the shell of the reeling cylinder, and conveying the web and the leader strip to the reeling cylinder 1.

The travel of the leader strip 3 corresponds to the travel of the web in such a manner that it is passed on the supporting belt 4 in the conveying section beginning from the reversing roll 5, to the reeling cylinder on which it travels on top of the supporting belt within a particular sector and is discharged from the supporting belt after the nip between the reel spool 2 and the reeling cylinder 1. After the discharge point the supporting belt continues its travel on top of the reeling cylinder 1 within a given sector and returns to the reversing roll 5. Advantageously, the threading takes place in such a manner that the leader strip and the web spread therefrom at a later stage travel over the reeling cylinder 1 within a given sector and the empty reel spool 2 is located in the actual reeling position, i.e. it is placed on the perimeter of

the reeling cylinder in a position from which it gradually begins to move further away from the reeling cylinder by the effect of the growth of the diameter of the reel, either on rails or in a carriage or supported by another supporting structure.

To ensure the transfer of the leader strip, a suction is arranged inside the belt loop, the suction keeping the tail attached to the supporting belt 4. The suction is effected by means of a suitable suction device 6, which is positioned underneath the conveying section to affect the leader strip on the opposite side of the supporting belt via the air permeable supporting belt. The suction device 6 can be a conventional suction box, which is connected to a suction channel, or it is advantageously of the type described hereinbelow.

At least part of the sector in which the leader strip 3 travels on the reeling cylinder 1, comprises a suction zone 7 inside the reeling cylinder. The suction zone can be produced by means of a technique known in connection with reeling cylinders provided with suction or by means of an advantageous embodiment presented hereinbelow. The suction zone is restricted to lie within a given sector inside the rotating perforated shell of the reeling cylinder by means of structures known as such. In Fig. 1 the suction zone 7 begins before the entry point of the supporting belt, and ends after the nip between the reeling cylinder and the reel spool. The length of the suction zone 7 can also be arranged in another manner. Below the nip in the vicinity of the reeling cylinder 1 there may be an air doctor directed against the direction of rotation of the reeling cylinder, i.e. a full-width slot blowing, which is utilized for preventing the winding of the tail or the web around the reeling cylinder 1 (arrow A).

In the situation of Fig. 1 the leader strip 3 has been guided by means of a suitable arrangement to the initial end of the conveying section of the supporting belt loop, wherefrom the supporting belt 4 transfers it on top of the reeling cylinder 1 and further on the perimeter of the reeling cylinder all the way to the point where the tail is detached from the supporting belt. The empty reel spool 2 is positioned against the belt, forming a draw nip, or the reel spool 2 is brought in contact with the

supporting belt and the leader strip 3 which travels on top of the belt and is narrower than the full-width web, to form a nip at a later stage. When the leader strip travels through the nip, the web is spread to full width by means of diagonal cutting, which can be conducted by methods known as such. Thereafter the full-width web travelling down through the nip is transferred around the reel spool 2 by means of a suitable method, for example by using blowings. When the end of the web is thus brought on the reel spool, it is possible to start a continuous reeling up to form successive machine reels.

Fig. 2 illustrates an advantageous manner in which negative pressure can be attained in the suction device 6 underneath the supporting belt 4 and in the suction zone 7 inside the reeling cylinder 1. The described structure can be used in both suction areas or in one of them, conventional suction channel technology being applicable in the other. According to Fig. 2, negative pressure is generated by means of blowings, which are directed out from nozzles 8 extending over the width of the tail or the web. The air current issued from the nozzles produces suction by means of an ejector effect, the suction acting on the leader strip 3 through the supporting belt 4 or through the perforated shell of the reeling cylinder 1 and the supporting belt on top of the same. The nozzles can be narrow nozzle slots extending in the lateral direction, or they may be formed of series of nozzle openings placed next to each other. There is a sufficient number of successive nozzles 8 in the longitudinal direction of the conveying section of the supporting belt 4, or in the longitudinal direction of the suction zone. The pressurized air supply, to which the nozzles 8 are connected, is marked with the letter P.

It is an advantage of the suction produced by means of blowing that large suction channels are not necessary, but pressurized air can be conveyed to the box underneath the supporting belt 4 or to the inside of the reeling cylinder 1 into the suction zone 7 along blowing channels of smaller dimensions.

Fig. 3 shows a more detailed sectional view of the apparatus according to Fig. 1, for the part of the suction device 6 inside the belt 4. The box-

like suction device 6 is shaped in such a manner that in the rear end it extends as far as possible into an opening gap, i.e. a wedge-shaped space between the supporting belt 4 and the reversing roll 5 and in the front end into a closing gap, i.e. a wedge-shaped space between the supporting belt and the reeling cylinder 1, wherein it can be formed in such a way that its rear and front walls follow the shell of the roll 5 and the shell of the reeling cylinder 1, respectively, for example to curve. The above-described nozzles 8 are located inside the box and they open from blow boxes of their own. The air current issued from the nozzles starts to follow the surface of the blow box succeeding the nozzle slot or corresponding nozzle structure, and turns downward thus generating negative pressure by means of an ejector effect. As can be seen in Fig. 3, the nozzles 8 can open in the travel direction of the belt and against the travel direction of the belt, and it is possible that nozzles open in opposite directions from the same nozzle box. The invention is not restricted to the above-presented nozzle constructions, but it is also possible to utilize other kind of placement of the nozzles to produce a negative pressure area bordered by the lower surface of the belt 4 by means of an ejector effect.

The air that is blown out of the nozzles 8 is discharged from the box formed by the suction device 6 down inside the loop formed by the supporting belt 4, wherefrom it can be conveyed away. The box is thus sufficiently open on its lower side, so that air can be discharged freely inside the belt loop. The box is sufficiently open on the top, so that the suction can act on the lower surface of the supporting belt 4, and to seal the negative pressure area bordered by the belt, it can be sealed laterally to the edges of the supporting belt 4 for example by means of a mechanical seal or by means of air blows directed sideways, which air blows can be obtained in a suitable manner from the pressurized air issued to the suction device 6 for blowings. Especially the boundaries between the reversing roll 5 and the reeling cylinder 1 and the supporting belt 4 are sealed laterally. When for example the gap opening between the reversing roll 5 and the supporting belt 4 in the beginning of the conveying section of the belt loop is sealed, it is possible to induce a negative pressure area in this point between the rear wall of the box of the suction device 6 and the reversing roll 5 by

the rotation of the reversing roll 5, the negative pressure area facilitating the transfer of the leader strip or the web to the supporting belt 4.

Fig. 4 illustrates as a detail the area of the closing gap between the supporting belt 4 and the reeling cylinder 1. As was mentioned above, the suction zone 7 advantageously begins before the point of contact of the supporting belt 4 and the reeling cylinder 1, i.e. it extends within the length of a sector α before said point of contact. Between the box of the suction device 6 and the free shell of the reeling cylinder 1 there is a seal 9, which is located in the direction of rotation of the reeling cylinder 1 in the same point where the suction zone 7 begins, at the latest, and preferably before the beginning of the suction zone, i.e. the length of the sector α is selected in such a manner that the suction is effective through the shell of the reeling cylinder 1 only in the area after the seal 9, before the contact point of the reeling cylinder 1 and the supporting belt 4. In this area following the seal 9, the gap is well sealed also laterally. The seal 9 can be a mechanical seal, for example a brush, but instead of a mechanical seal, it is also possible to use sealing blowings directed against the direction of rotation of the reeling cylinder, which sealing blowings can take air from the same pressurized air source P as the air required by the nozzles 8.

It is also possible to arrange the front wall of the box of the suction device 6 open in the area inside the seal 9 in such a manner that the suction from the suction zone 7 of the reeling cylinder 1 is also capable of affecting the box, as is presented in Fig. 4.

As was stated above, the same ejector blowing solutions as those used inside the suction device 6 according to Fig. 3, can be applied in the suction zone 7 inside the reeling cylinder 1. The suction zone is separated from the other interior of the cylinder by means of suitable division walls. The blowing air can be brought from the pressurized air source through the end of the cylinder 1 to the blow boxes inside the zone 7, the boxes being provided with nozzles 8, for example nozzle slots or series of nozzle openings, and the air issued from the nozzles 8 can be allowed to be discharged in the radial direction to the centre of

the cylinder and further conducted out of the centre through the end of the cylinder. The blowings directed away from the shell of the reeling cylinder produce a negative pressure area bordered by the inner surface of the shell.

Fig. 5 shows in perspective the threading of the web in the form of a leader strip 4, which is narrower than the full-width web. The strip can be formed of a so-called edge strip separated from the edge of the full-width web, but it can also be formed of a strip separated from the central area of the web, as shown by broken lines in Fig. 5. Fig. 3 also shows the alternatives according to which the suction device 6 and/or the suction zone 7 are effective in an area which is narrower than the travel width of the full-width web, for example in that point where the leader strip 4 travels. If the suction zone 7 of the reeling cylinder 1 is narrower than the reeling cylinder and located in its one edge, the shell of the reeling cylinder has to be air permeable only within this width, and in addition, it is possible to use an arrangement in which the rotation shaft and the shell of the cylinder 1 are connected together to transmit rotating motion in the area inside the outer edge of the shell in such a manner that a sleeve-like recess remains at the perforated edge area of the shell, inside which the structure accomplishing the suction zone 7 can be placed and connected to the suction or pressurized air, depending on the manner in which the negative pressure is generated.

Furthermore, it is possible to divide the suction device 6 or the suction zone 7 in compartments in the lateral direction for example in such a manner that blowing is conducted only to the compartment located by the leader strip, i.e. it is active in order to draw the strip 3 against the supporting belt 4. When after the leader strip 3 a widening web or a full-width web is conveyed, the area of influence can be extended to span the width of the entire suction device 6 or the suction zone 7 in such a manner that the air blowing is discharged from the nozzles 8 across the entire width of the device 6 or the zone 7.

Fig. 6 shows the threading of the tail of the web in the form of a full-width paper web W. Thus, it is obvious that the suction is effective within the entire width of the web in the suction device 6 and in the

suction zone 7. In this case they can also be arranged in compartments to take into account the possibility that the threading is conducted in the form of a strip which is narrower than the full-width web.

The embodiments of the invention can vary within the limits set by the appended claims. A precondition for a successful threading is that a suction is exerted on the leader strip or to the full-width web at least from inside the reeling cylinder 1, but the area in which the adherence of the leader strip or the full-width web has been ensured within a long distance can be attained by arranging a suction also before the reeling cylinder in the conveying section of the supporting belt.

Other rolls than the reversing roll 5 can also guide the loop of the supporting belt 4. The supporting belt 4 is detached from the reeling cylinder in a suitable point in the area of its lower half (the section of the shell below the horizontal plane extending through the rotation axis), preferably in the direction of rotation within an angular distance of 30 to 150° from the horizontal plane. Guiding rolls may be located outside and/or inside the belt loop in the return section of the supporting belt 4, which begins after this point.

The supporting belt 4 itself can also travel as a narrow belt via the reeling cylinder 1 outside the outer edge of the actual web, having light weight suitable for the leader strip. The principle of the travel of the belt when seen from the side, is thus the same as the one presented above, and at the point of location of such a narrower belt it is possible to utilize a suction device 6 or a suction zone 7 with a corresponding width.

Claims:

1. Method for threading a tail of a web in a reel-up of a paper web, in which a paper web (W) is passed over the shell of a reeling cylinder (1) on top of an air permeable supporting belt (4) to contact with a reel spool (2) while the web is kept against the belt by means of a suction effective through the shell of the reeling cylinder, **characterized** in that the supporting belt (4) is passed in a loop around the reeling cylinder (1), which forms a reversing cylinder for the loop of the supporting belt (4).

2. Method according to claim 1, **characterized** in that the web (W) is kept against the belt by means of a suction effective through the run of the supporting belt (4) before the reeling cylinder (1).

3. Method according to claim 1 or 2, **characterized** in that the suction through the shell of the reeling cylinder (1) is effected by flows of a gaseous media blown from the nozzles (8) inside the shell of the reeling cylinder (1).

4. Method according to claim 2 or 3, **characterized** in that the suction through the supporting belt (4) is effected by flows of a gaseous media blown from the nozzles (8) inside the belt loop.

5. Method according to any of the foregoing claims, **characterized** in that the tail of the web (W) is threaded in full width by means of the supporting belt (4).

6. Method according to any of the foregoing claims, **characterized** in that the tail of the web (W) is threaded by means of the supporting belt (4) as a strip (13), which is narrower than a full-width web (W).

7. Apparatus for threading the tail of a web in a reel-up of paper web, which comprises an air permeable supporting belt (4) passed via a reeling cylinder (1) which is journalled rotatable, and inside the reeling cylinder (1) means for generating a suction effective through the shell of the reeling cylinder, **characterized** in that the supporting belt (4) is

passed in a loop around the reeling cylinder (1) which forms a reversing cylinder for the loop of the supporting belt (4).

8. Apparatus according to claim 7, **characterized** in that in the travel direction of the supporting belt before the reeling cylinder (1) there is a suction device (6) which is arranged to act through the supporting belt (4).

9. Apparatus according to claim 7 or 8, **characterized** in that means for generating the suction effective through the shell of the reeling cylinder (1) comprise blow nozzles (8) which are placed and directed in such a manner that they produce a negative pressure area bordered by the inner surface of the shell.

10. Apparatus according to claim 8 or 9, **characterized** in that the suction device (6) effective through the supporting belt (4) comprises blow nozzles (8) which are placed and directed in such a manner that they generate a negative pressure area bordered by the inner surface of the supporting belt (4).

11. Apparatus according to any of the foregoing claims 7 to 10, **characterized** in that inside the reeling cylinder (1) the suction zone (7) effected by said means begins (sector α) before the contact point of the supporting belt (4) and the reeling cylinder (1).

12. Apparatus according to claim 11, **characterized** in that in the direction of rotation of the reeling cylinder (1) in the beginning of the suction zone (7) of the reeling cylinder (1), at the latest, there is a seal (9), such as a mechanical seal or a blowing, which is effective against the shell of the reeling cylinder (1) and isolates an area in the direction of the perimeter of the reeling cylinder (1) from the rest of the inner part of the loop of the supporting belt (4), the area being bordered by the contact point of the supporting belt (4) and the shell of the reeling cylinder (1).

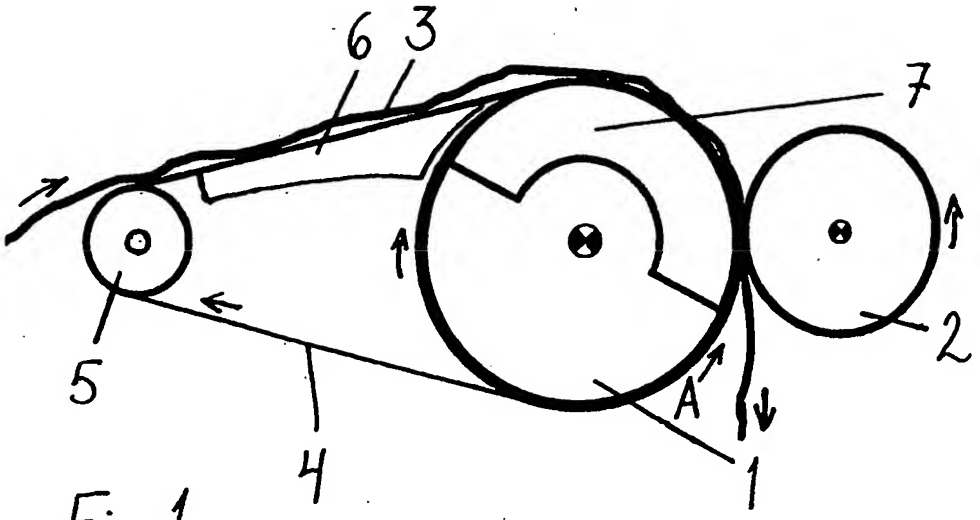


Fig. 1

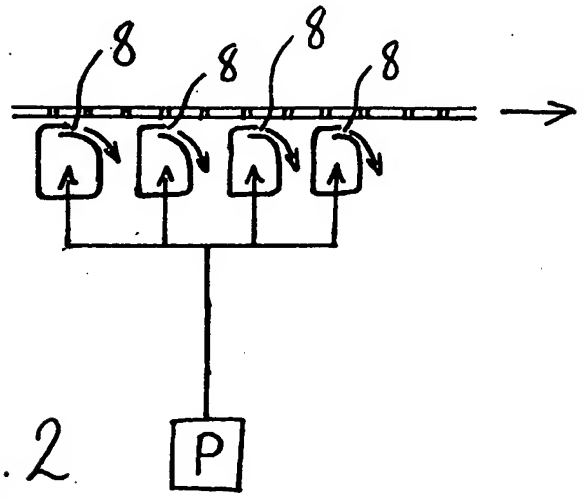


Fig. 2

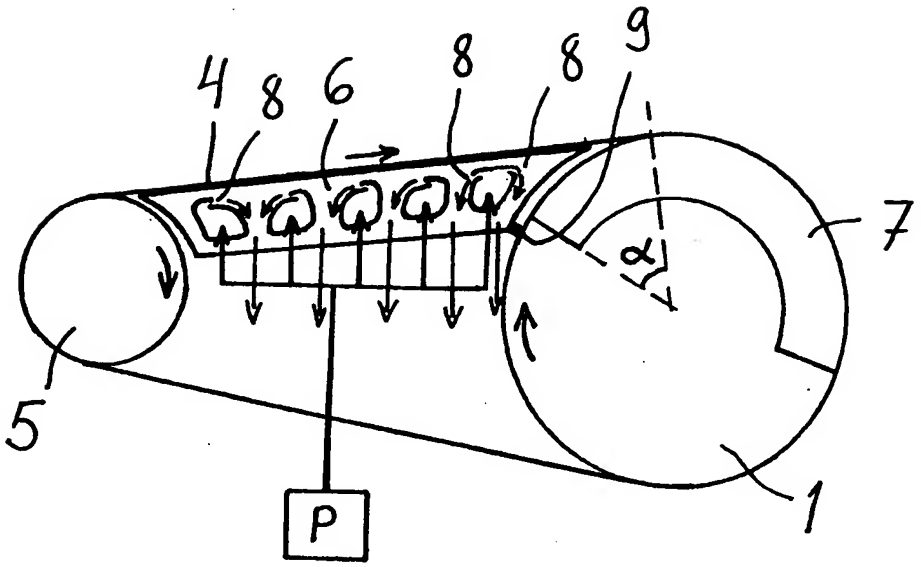


Fig. 3

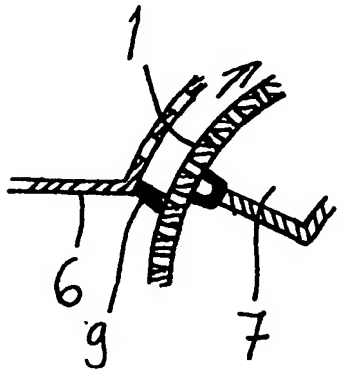


Fig. 4

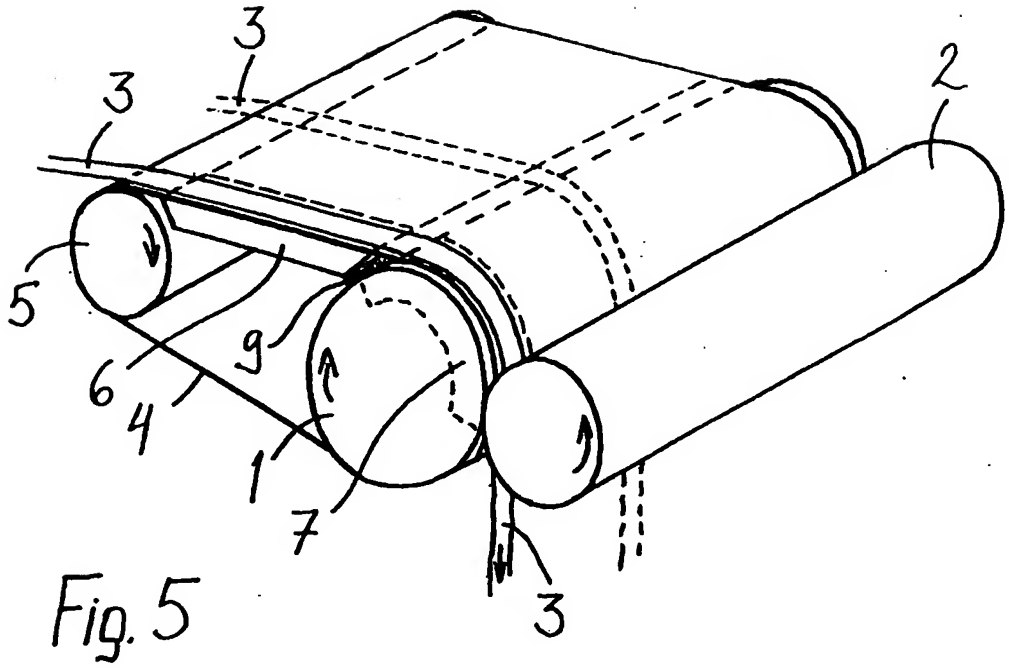


Fig. 5

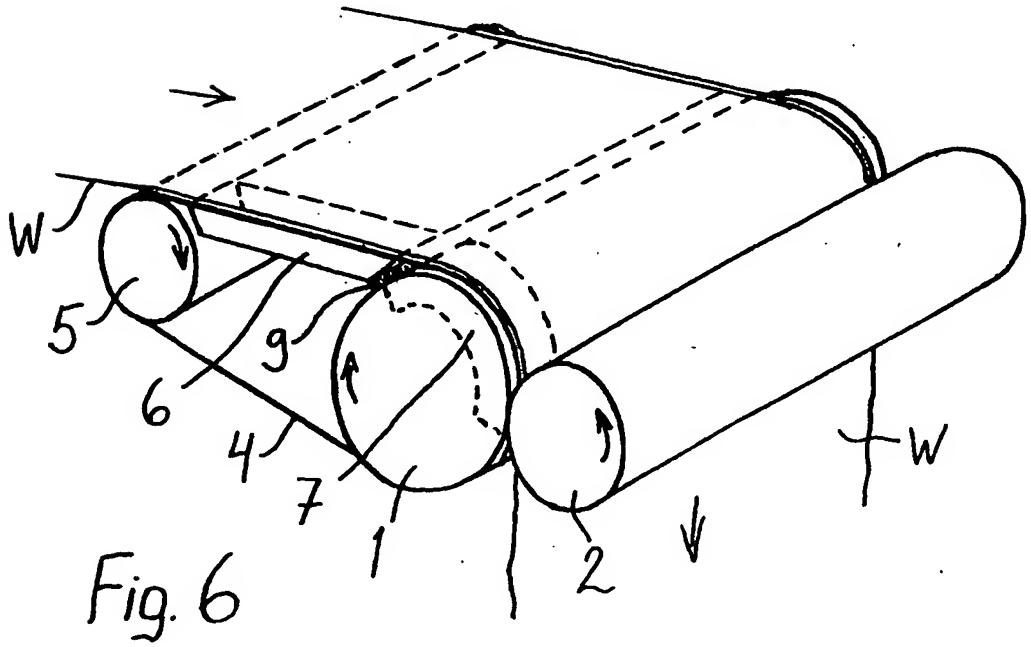


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/00442

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B65H 19/22
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B65H, D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI,PAJ,EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0658504 A2 (VALMET PAPER MACHINERY INC.), 21 June 1995 (21.06.95), figures 1,9, claims 1,5, 6-7,11-13; abstract --	1,2,5-8, 11-12
X	WO 9515901 A1 (BELOIT TECHNOLOGIES, INC.), 15 June 1995 (15.06.95), claims 1,2,6, abstract --	1,7
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INTERNATIONAL SEARCH REPORT

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